

Travel Through Smoke

Instructor's Copy

Mining Systems and Human Engineering
U. S. Bureau of Mines
Pittsburgh, Pennsylvania

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Introduction

This document contains most of the materials needed to use the exercise. The main part of the document is the instructor's copy. It tells how to use the exercise, presents the objectives, the master answer sheet, the scoring key, and discussion notes to be used following the exercise. The last part of this document is three appendices. Appendix A is the exercise problem booklet. This booklet can be duplicated locally. The booklets are reusable. One is needed for every person in the classroom. Appendix B is the answer sheet. Copies of this answer sheet must have the invisible ink answers that appear in Appendix C printed on them.¹ Answer sheets are consumable. One is needed for each group of 3 to 5 persons who work the exercise.

Exercise Summary

Read this section first. It determines if the exercise is appropriate for your classes. If you choose to use the exercise, examine the table of contents and review the remainder of this document.

Type:	Invisible ink
Audience:	Underground coal miners
Length:	Ten questions (40 minutes for administration plus 20 for discussion)
Skills:	Escape strategies and procedures including choice of routes, use of emergency breathing apparatus, information gathering, and communication Ordering priorities and making life and death decisions when faced with a hostile environment and insufficient means and times for all miners to escape from a section
Location:	Underground coal mine section, 72 inch seam height
Problem:	You are the section foreman on the 4 North longwall development section which has four entries. The belt conveyor has a CO monitoring system and a fire alarm system. The CO monitor has gone off three times in the last hour. Each time the alarm went off, you alerted your crew, sent someone to check the belt, and called the dispatcher. Your investigations each time revealed no smoke or fire. While checking materials in a supply car with the section utility man, you get a strong smell of smoke. As the crew assembles, smoke begins coming in on the section. Although you contact the dispatcher to find out where the smoke is coming from, he is unable to find out anything before the smoke starts to become heavy on the section. You and your crew don your SCSRs, board the portal bus, and leave the section. As you travel out of the section, the smoke becomes so thick that the operator cannot see to continue. You decide to leave the bus and move into the primary escapeway and continue your escape on foot.

¹ You can do this yourself if you have the proper equipment, or you may obtain copies of preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

How to Use This Exercise

1. Look at the performance objectives. Decide if the exercise is relevant for your mine training class.
2. Work through the exercise with the developing pen and score your responses.
3. Read the master answer sheet for the exercise. Look at all the answers.
4. Read the "Instructor's Discussion Notes" for the exercise.
5. Become thoroughly familiar with the problem so that you can present it to your class without reading it. Put the figure on an overhead projector so you can use it to help explain the problem.
6. When you present the exercise to the class:
 - Give each person an exercise booklet, and each group of 3 to 5 an answer sheet and a developing pen.
 - Demonstrate how to select and mark answers using the developing pen.
 - Go over the instructions for working the exercise with the whole group.
 - Explain the problem, making sure everyone understands the problem situation.
 - Have the class members work the exercise.
 - When the class members finish, have them figure up their score using the instructions at the end of the exercise.
 - When everyone has finished, discuss the exercise. Let class members discuss the merits of each answer. Add your own ideas.

Performance Objectives for Travel Through Smoke

Objective number	Capability verb(s)	Description of required performance and conditions under which it is to occur
1. EE/SR ²	Recognize Comprehend	The lifesaving value to section crews of accurate and prompt communication by surface personnel concerning the location and size of a mine fire
2. EE/SR	Recognize Recall	The purpose and utility of designated assembly points for evacuation of mine sections during emergencies
3. EE/SR	Anticipate Predict	The probable rate and direction of smoke movement through a section given a mine map with ventilation arrangements and air velocity values
4. EE/SR	Select Evaluate Adjust	Escape strategies and routes from a mine given a section map, information about conditions on the section, and little information about the source and location of smoke on the section
5. EE/MG	Recall Apply	Basic information and facts about the toxic effects of carbon monoxide, oxygen deficiency, the capabilities and limitations of filter self-rescuers and self-contained self-rescuers when planning and executing escapes from heavy smoke on a mine section
6. EE/SR	Evaluate Judge Debate	Merits and risks associated with traveling via self-propelled vehicle through a smoke filled, hostile environment to escape as opposed to leaving the section on foot.

² Skill and knowledge domain abbreviations:

EE = evacuation and escape

SR = self-rescue

MG = mine gases

Master Answer Sheet for Travel Through Smoke

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need. The last part of the message may tell you what to do next.

Question A (Select as MANY as you think are correct.)

1. [Correct. This alerts the others and provides you with more information.]
2. [Finding the source of the smoke is important, but the safety of your crew is
[the number one priority. If the crew smells smoke and finds you]and the bus
[gone, they may be alarmed.]
3. [Correct. You should make a quick inspection to confirm that the source of the
[smoke is not on your section.]
4. [As foreman, you should not depend on second hand information. You should
[talk to the dispatcher yourself.]

Question B (Select as MANY as you think are correct.)

5. [Pulling equipment from the face wastes time.]
6. [This action splits up your crew and restricts your options. You may need the
[portal bus to escape.]
7. [Correct. He tells you that there are no other vehicles on your section at this
[time.]
8. [You have a problem now. Time may be precious and your escape may be
[compromised if you fail to act promptly.]
9. [Correct. The dispatcher says he'll do that right away and get back to you as
[soon as possible.]

Question C (Choose only ONE unless you are told to "Try again!")

10. [Correct. Everyone is present. Do the next question.]
11. [This wastes time. A fire could cut communications and/or block your escape]
[while you wait by the phone. Try again!]
12. [Unnecessary and this wastes time. Try again!]
13. [You should not leave the phone. It is probably a good idea to pressurize that]
[entry to help reduce the amount of smoke in that entry. But you haven't]
[already planned for this and it would take too much time to do it now. Try]
[again!]
14. [The FSR should be used only to get to the SCSRs, or only as a last resort]
[when the SCSRs have been exhausted. Try again!]

Question D (Select as MANY as you think are correct.)

15. [Correct. You may need these later.]
16. [You don't need this and it will slow you down.]
17. [You need to get the SCSRs on the crew now. At this time you and they could]
[be breathing potentially fatal air.]
18. [Correct. Two miners didn't have their nose clips on and three others had poor]
[strap adjustment. These problems need to be corrected before the crew]
[begins to move out.]
19. [Correct. He needs this information, even if he doesn't have any information]
[for you.]
20. [Correct. You may need this information later. It is 10:35 P.M.]

Question E (Select as MANY as you think are correct.)

21. [You have a long distance to travel on foot, you don't know where the fire is,]
[and although there is some smoke, it could get worse later. You should ride]
[as far as you can on the portal bus because it is quicker and will take less]
[energy for you and your crew.]
22. [Correct. You will be wearing an SCSR and won't be able to communicate well.]
[Since you will be in smoke either way you go, it is probably better to ride. He]
[says there is still no information about a fire but he will keep you posted. He]
[suggests that you can answer his questions about your progress by clicking]
[your haulage talkie mike twice for yes and once for no.]
23. [Correct. The choice is whether to walk in the intake smoke or ride out the]
[smoky secondary. You will therefore probably be traveling the track entry and]
[the smoke may get heavier. To ensure the safety of your crew there should]
[be no vehicles on the track.]
24. [He should be communicating with you as you ride out on the portal bus.]
[Besides, you may be in heavy smoke at the mouth of the section.]
25. [Correct. Visibility will be reduced as the smoke becomes thicker. If it]
[becomes too thick, it may become impossible to find a mandoor that leads]
[to the primary escapeway.]

Question F (Select as MANY as you think are correct.)

26. [Correct. Any stops of the portal bus should be at mandoors.]
27. [This wastes time. You need to go as far as possible with the least effort.]
[Riding the portal bus is the best way to do this.]
28. [If you go faster you could wreck.]
29. [Correct. Riding the bus is still the quickest means of escape and traveling]
[slow will help prevent possible problems.]
30. [Don't remove your SCSR mouthpiece and nose clip. This encourages your]
[crew to do the same and people may die. Communication should be by hand,]
[lamp signal, or written note.]
31. [Never remove the SCSR mouthpiece or nose clips until you are outside, in]
[known fresh air, unless you need to don a new unit!]

Question G (Select as MANY as you think are correct.)

32. [Visibility is poor whether you are riding or walking and will likely get worse]
[with time. Besides, there may be tripping and stumbling hazards in the]
[smoke. You have better options.]
33. [Correct. The portal bus is still the best way to travel provided you go slowly.]
34. [Correct. You and the crew should not be taking the SCSR mouthpieces]
[out to talk. This is very dangerous.]
35. [This delays your escape by going inby rather than outby.]

Question H (Choose only ONE unless you are told to "Try again!")

36. [The dispatcher may not have any more information to give you. Also, the]
[talkie communications could be lost due to the fire. Try again!]
37. [This may separate the crew or disorient them. Try again!]
38. [Correct. Since the visibility is getting worse in the alternate escapeway,]
[you need to check the primary escapeway to see if the visibility is better.]
[You find that there is light hazy smoke in #3. The lifeline keeps you in]
[contact with your crew. Do the next question.]
39. [You and your crew may become separated. You also told the dispatcher]
[earlier that you might move into the primary escapeway if the smoke]
[became too heavy. Try again!]

Question I (Select as MANY as you think are correct.)

40. [Correct. Everyone is present. It is now 10:55 P.M.]
41. [You should keep the group together.]
42. [Correct. This way you will have someone to help at both ends of the]
[line.]
43. [This may create problems. Move at a deliberate pace.]
44. [Correct. This can help keep the group together.]
45. [Correct. This will help the miners adjust to breathing with their SCSRs]
[while they are walking, help them to avoid hyperventilating, and help]
[prevent "cheating" by taking extra breaths of the mine air around the]
[SCSR mouthpiece.]

Question J (Choose only ONE unless you are told to "Try again!")

46. [Although you are in clear air, CO may be present. Also, smoke can come in at]
[any time. You and your crew need to keep your SCSRs on. Try again!]
47. [Even though you are in clear air, smoke can come in at any time. Your crew]
[needs to stay together as a group so that no one becomes separated.]
[Try again!]
48. [Correct. You and your crew need to keep your SCSRs on since CO might be]
[present. You and your crew also need to stay together.]
49. [You need to stay with your crew so that you don't become separated.]
[Besides, there may not be a mine phone close that can be safely reached.]
[Try again!]

End Of Problem

Finding your score

Number of "Correct" answers you colored in = (1) _____

27 minus number of incorrect answers you colored in = (2) _____

Add lines one and two to get your total score = (3) _____

Highest possible score = 49

Lowest possible score = 0

Instructor's Discussion Notes

It is helpful to show overhead transparencies of the master answer sheet during the discussion while the miners look at their problem booklets. This allows you to lead the group through the exercise and to disclose and discuss all the answers to each question. Most of the information about why particular answers are correct or incorrect is given on the master answer sheet.

The following notes provide additional information for you to discuss with your class. Read through and think about the notes before the class. Incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion of the exercise.

Question A - The correct answers are to (1) send the section utility man to alert the crew and (3) to quickly check the section to be sure the source of the smoke is not on the section. Miners working at the face need to be alerted that there might be a problem, especially since there were several false alarms with the CO detector system. At the same time, the foreman needs to contact the dispatcher to find out where the smoke may be coming from. While it is doubtful that the source of the smoke is on your section, you need to confirm this. Sending the utility man to alert the crew while you travel outby to locate the source of the smoke (2) would separate you from your crew and waste time. Other methods, such as asking for this information from communications personnel on the surface, should be used for determining the location of the source. Having the utility man contact the dispatcher while the foreman alerts the crew (4) is not advised. Since the foreman is responsible for the crew's safety, he or she should be the person contacting the dispatcher to obtain necessary information.

Question B - The correct answers are (7) to find out if anyone else has come onto your section and if the track is clear to the mains, and (9) to have someone check on the source of the smoke. At this point, you do not know what the source of the smoke is. If you learn that there is a serious problem and must evacuate the section, backing the equipment out of the faces (5) would waste valuable time. Sending the mechanic outby to find the source of the smoke (6) could be dangerous and will also waste time. Waiting to see what happens or for directions from the shift foreman (8) will also waste valuable time and may jeopardize your escape.

Question C - The correct answer is (10) to count how many people assemble at the power center to ensure that your entire crew is together. Waiting for the dispatcher to get more information on the situation (11) wastes valuable time and could result in you and your crew being trapped inby. Hanging line brattice (12) is unnecessary and would also waste time. Research has shown that pressurizing an intake airway can reduce the amount of smoke that may filter into it from other entries. Hanging a curtain and pressurizing Entry #3 (13) is a good idea for helping to potentially reduce the amount of smoke in the primary escapeway, but you may not have materials readily available and time could be wasted. Although the smoke is coming into the section, having the crew don filter self-rescuers (FSR) and wear them until the smoke gets heavier (14) is not advisable. Miners are assembling at the power center where 10 SCSRs are available. In addition, 12 SCSRs are stored on the mantrip. Miners should don the SCSRs from the

power center cache first. The FSRs should be used only to reach caches of SCSRs or as a last resort when all SCSRs have been exhausted.

Question D - Correct answers for this question are 15, 18, 19 and 20. Obtaining the rope and hand axe (15), having all crew members don their SCSRs and check each other (18), calling the dispatcher to inform him that you are preparing to leave the section (19), and making a note of the time so that you will have some sense of how long you have worn your SCSR (20) are all actions that need to be taken while preparing to depart the power center. While the rope and axe from the fire barrel could be needed during escape, it is doubtful that the crew will be engaged in fire fighting activities. There is no need to take the fire hose and nozzle (16). Since the smoke is becoming heavier, miners need to don their SCSRs as soon as possible. Taking extra SCSRs and donning the apparatus on the way out of the mine (17) could cause serious problems. The smoke could become worse, CO levels may increase, and oxygen deficiency may develop.

Question E - Correct answers for this question are 22, 23 and 26. You must notify the dispatcher that you and your crew are leaving the section on the portal bus and for him to keep in touch (22), tell the dispatcher to keep the section track clear (23), and advise the dispatcher that you and your crew may move into the primary escapeway if smoke in the alternate becomes too heavy (25). Although there is smoke in the primary escapeway, you have not determined the location of the fire. Therefore, you don't know how far you may have to travel to get out by the fire. Choosing to walk the primary escapeway (21) is ill advised since it will take longer and require more effort. You have advised the dispatcher to communicate with you as you ride out on the mantrip. There is no real need to call from the mine phone at the belt head drive (24). Besides, if the smoke is heavy or if the fire is in this area, you may not be able to get to the phone.

Question F - The correct answers are 26 and 29. You should count crosscuts (26) so that you know where the nearest mandoor is located and signal the portal bus operator (29) to slow down and proceed with caution. While the smoke is getting heavier and visibility is becoming worse, you should not stop now and check the primary escapeway in entry #3 because it will waste time (27). Your objective is to try to ride as far as possible on the portal bus. Going faster in the portal bus (28) is not advised. This is dangerous since the visibility is poor and you could easily wreck by hitting another vehicle or object on the track. While crew members may be apprehensive about the situation, do not talk to your crew (30). You would have to take out your SCSR mouthpiece to do this. As a result, you and other crew members could easily be overcome by carbon monoxide (CO). While you would like more information on the location of the fire, you should not remove your SCSR to call the dispatcher (31). Besides, you have already told him of your plans.

Question G - The correct answers are 33 and 34. You must both signal the operator to continue very slowly (33) and signal him to put his SCSR mouthpiece back in (34). Even though you can hardly see the stoppings in the crosscuts, you should not stop the portal bus now (32), but should continue on as far as the next mandoor. At the same time, you don't want to reverse direction and go back to the last door (35). You need to proceed toward the mouth of the section.

Question H - The correct answer to this question is (38) to signal the operator to stop the bus while you go and check the #3 entry. It's important to secure the rope to yourself and someone on the bus. Even though you can still see the mandoor, the smoke can quickly become too thick for you to find your way back to the portal bus. The rope provides a life line for you. Since you can barely see the mandoor, you should not continue while waiting to hear from the dispatcher (36). The smoke could become so thick that you may not be able to locate the next mandoor. In addition, trolley phone communications could be lost due to the fire and you may never hear from the dispatcher. You should not stop the mantrip and have your crew follow you through the mandoor (37). You need to check the escapeway first and also use some means to keep them together since the smoke is thick. There is no need to have another miner lead your crew through the mandoor into the primary escapeway while you call the dispatcher to report what you are doing (39). This wastes time and you could easily become separated from your crew in the thick smoke. Besides, you told the dispatcher before leaving the section that you would move into the primary escapeway if the smoke became too heavy in the primary.

Question I - The correct answers are 40, 42, 44 and 45. It's important to make a head count (40) to ensure that your crew members are accounted for, and checking the time is important as you need to know how long you have been breathing from your SCSR. Having miners hold onto the life rope while walking out at a moderate walking pace (45) and spaced equally (44) will help keep the crew together. Although you (the foreman) may know the escapeways well, you need to place the miner on your crew with the most knowledge of the escapeways (42) at the rear of the group. If the crew accidentally becomes separated, there will be someone else who can lead these individuals out of the mine. You should not send a miner ahead to check the escapeway (41) since this will separate him from the crew. When walking out, do not set a fast pace (43). A moderate, but steady pace will help reduce fatigue and make it easier to breathe through the SCSR.

Question J - The correct answer is (48) to signal your crew to keep their mouthpieces in and to follow you through the mandoor. Even though you reach clear air and some miners may be having trouble breathing from their SCSR, you should never take the device off (46). CO may be present and smoke could come in at any time. While your crew is tired, you should not stop and send a miner to look for the mandoor (47). You need to keep the crew together so that no one becomes separated. Going to call the dispatcher while your crew rests (49) is not advisable. There may not be a mine phone close and you will become separated from your crew.

The idea for the subject of Travel Through Smoke was developed by a safety director of a major coal company. Mines operated by this company use a dispatcher for directing all traffic movements on the haulage and for maintaining communications with the surface. Today, many mines no longer use dispatchers. Rather, they rely on a communications person on the surface. If your mine utilizes a surface communications person, discuss with the class how this would affect an escape at your operation.

This mine placed manddoors at regular intervals: every 5 crosscuts. Since many mines do not follow this practice, discuss how the arrangement of doors at your operation would affect an escape at your mine.

Interviews with nearly 50 miners who have escaped underground mine fires reveal that a number of them delayed donning their SCSR. Many said that they "saved" their SCSRs because: 1) they knew that the devices were designed to provide only 60 minutes worth of oxygen and 2) they often did not know where the fire was located and how far they would have to travel to get outby the fire. As a result, 67.4% of the workers reported that they donned their SCSR in smoke. In addition, miners traveled through smoke bare-faced for 10 minutes before donning their SCSRs.

A number of miners interviewed indicated that they did not know where the fire was located and that no one took sufficient time to find out. Most miners said that if they had known the location of the fire, they would have donned their SCSRs sooner. Discuss the importance of obtaining ample information about the fire's location. Emphasize that SCSRs (or FSRs) need to be donned as soon as possible. Be sure miners understand that a delay in donning the devices is dangerous because carbon monoxide can be present even in apparently clear air. Discuss what can be done to assist miners in obtaining adequate information about the location of the fire from the dispatcher or communications person before escaping.

This exercise emphasized the importance of riding out the alternate escapeway on a mantrip as far as possible. The purpose was to reduce the amount of effort that miners would exert when escaping. Some miners say that it is better to ride as far as possible before continuing escape on foot, especially if you do not learn the location of the fire and are not sure how far you may have to walk before getting outby the fire. Other miners maintain that, because of thick smoke in the alternate escapeway, one should automatically choose a primary escapeway and walk from the beginning if the smoke is lighter in this escapeway. Discuss this point with your class and what can be done to help a miner safely exit a mine during a fire.

References

- Brnich, M. J., Vaught, C., and Mallett, L. G. (1992). SCSR proficiency requires hands-on practice. COAL vol. 97, no. 7, pp. 52-54.
- Brnich, M. J., Vaught, C., and Wiehagen, W. J. (1991). Methods for maintaining self-contained self-rescuer donning proficiency. Proceedings, Training Resources Applied to Mining 18th Conference, pp. 145-154.
- Vaught, C., and Wiehagen, W. J. (1991). Escape from a mine fire: emergent perspective and work group behavior. Journal of Applied Behavioral Sciences, vol. 27, no. 4, pp. 452-474.

Scoring Key for Travel Through Smoke

The correct answers are marked with an asterisk.³

Question	Answer Number					
A	1*	2	3*	4		
B	5	6	7*	8	9*	
C	10*	11	12	13	14	
D	15*	16	17	18*	19*	20*
E	21	22*	23*	24	25*	
F	26*	27	28	29*	30	31
G	32	33*	34*	35		
H	36	37	38*	39		
I	40*	41	42*	43	44*	45*
J	46	47	48*	49		

³ This page is printed in large type so that it may be copied and used as an overhead transparency.

Appendix A: Problem Booklet

Duplicate this copy of the problem booklet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable.

You may obtain a copy of the problem booklet from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

Travel Through Smoke

Problem Booklet

Mining Systems and Human Engineering
U. S. Bureau of Mines
Pittsburgh, Pennsylvania

Instructions

Read the problem described on the next page. Next, answer each of the 10 questions. Do them one at a time. Don't jump ahead, but you may look back to earlier questions and answers. Some questions direct you to select all of the answers that you think are correct. Other questions ask you to choose only one answer unless you are told to "Try again!" Follow the directions for each question.

After you have selected your choice to a question, look up its number on the answer sheet. Select your answer(s) to each question by rubbing the developing pen between the brackets on the answer sheet. A hidden message will appear and tell you if you are right and may give you additional information. When you have finished you will learn how to score your performance.

Background

You are a floating boss and today you are the section foreman on 4 North, a longwall development section. Before taking a management position, you were a fire boss for five years.

The coal seam is 72 inches.

This is a 4 entry section that has been driven 4,000 ft from the mains.

The 42 inch section belt is located in #1 entry. Belt air moves inby from the dumping point to the tailpiece.

The belt has a CO monitoring system and a fire alarm system. The fire alarm alerts only the section crew. The CO monitor alerts both the section crew and the dispatcher.

Including yourself, there are 8 persons working on this section.

SCSRs are stored both at the power center (10) and on the mantrip (12). You do not have a hand held CO detector.

The fire barrel at the power center contains a hand axe, a hose nozzle, and 500 ft of fire hose.

A 100 ft length of rope is kept at the SCSR cache at the power center. The primary escapeway is the #3 entry, which is the main intake entry. The alternate escapeway is the #2 track entry.

The mine uses battery rail haulage for moving supplies and personnel. Communications is by radio, or "haulage talkie".

At this mine manddoors are located at every fifth crosscut when possible.

Problem

The CO monitor has gone off three times in the last hour. Each time the alarm went off you alerted your crew, sent someone to visually check the belt, and called the dispatcher. Your investigation found no smoke or fire. There have been problems with the CO monitoring system giving false alarms.

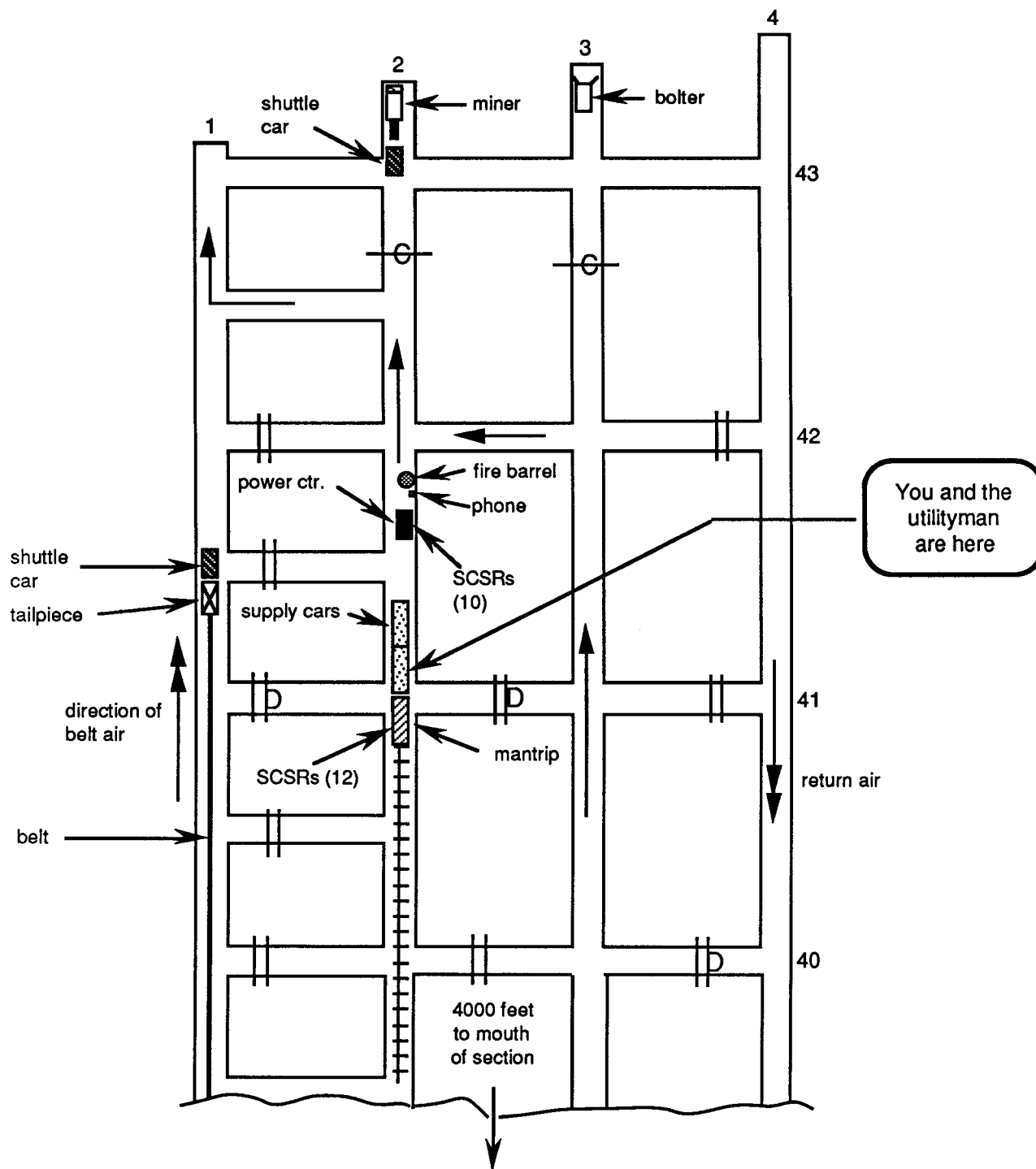


Figure 1: Section map for 4 North (not to scale)

Question A

You and the section utility man are checking materials at the supply car in entry #2. (See Figure 1.) You get a strong smell of smoke. What should you do? (Select as MANY as you think are correct.)

1. Send the section utility man to the face to alert the crew that there might be a problem and return to the power center, while you go to the phone to call the dispatcher.
2. Send the section utility man to the face to alert the crew that there might be a problem and return to the power center, while you take the portal bus and travel outby to try to locate the source of the smoke.
3. Take a quick look around for the source of the smoke.
4. Send the section utility man to call the dispatcher while you go to the face to alert the crew.

When you have made your selection(s), do the next question.

Question B

The utility man has gone to the face to alert the rest of the crew and has returned. You are talking to the dispatcher. He asks, "Is it your CO monitor again?" You say, "No, I smell smoke." What should you do now? (Select as MANY as you think are correct.)

5. Tell the dispatcher you are pulling the equipment out of the face and assembling the crew at the SCSR cache.
6. Tell the dispatcher you are sending the mechanic outby in the portal bus to check on the smoke while you stay by the phone and your crew assembles.
7. Ask the dispatcher if the section track is clear to the mainline.
8. Tell the dispatcher that you will monitor the situation closely to see if there is a problem, or wait until you hear from him or the shift foreman.
9. Ask the dispatcher to send someone to check out the situation.

When you have made your selection(s), do the next question.

Question C

While waiting for the dispatcher to have the situation checked, you see smoke rolling in like wisps of fog. You decide to knock the power and send the utility man to assemble the crew. While the crew is assembling at the power center, the smoke smells even stronger. What should you do now? (Choose only ONE unless you are told to "Try again!")

10. Make a head count.
11. Tell the dispatcher you and the crew will wait by the phone until he calls you with more information.
12. Send two miners to the face to hang a line curtain in #2 entry to prevent methane accumulation because the auxiliary fan has been de-energized.
13. Take a miner with you to check the air in #3 entry (your intake or primary escapeway), and, if the air is clean, place a check curtain just outby crosscut #42.
14. Have everyone put on their filter self-rescuer (FSR) right now and wear it until you get into heavier smoke.

Question D

The smoke appears to be slightly heavier in the track entry and is beginning to smell like coal. Visibility is about 200 feet. The utility man says that there is also smoke in the #3 entry. It is time to leave. You still haven't heard from the dispatcher. What actions should you take as you prepare to depart the power center with your crew? (Select as MANY as you think are correct.)

15. Assign a miner to get the 100 ft length of rope from the SCSR cache and the hand axe from the fire barrel.
16. Get the hose nozzle and the 500 ft of fire hose from the fire barrel to take with you.
17. Tell everyone to bring an SCSR from the portal bus so that each person will have one in addition to those at the cache. Tell them you will don the SCSRs on your way out.
18. Tell everyone to don an SCSR from the cache and check each other to make sure the devices are working and that they are donned correctly.
19. Call the dispatcher and tell him you are preparing to leave the section.
20. Make a note of the time.

When you have made your selection(s), do the next question.

Question E

While the crew is donning and checking their SCSRs, you make another call to the dispatcher because he hasn't called you. What should you communicate at this time? (Select as MANY as you think are correct.)

- 21. Tell the dispatcher that you and the crew are walking out the #3 entry, which is your primary escapeway.
- 22. Tell the dispatcher that you are coming out on the portal bus. Remind him that he must keep you updated without your having to call him for information.
- 23. Tell the dispatcher to keep the section track clear.
- 24. Tell the dispatcher that you will call him from the phone at the head drive when you get to the mouth of the section.
- 25. Tell the dispatcher that you have smoke in the track entry and in the primary escapeway. Advise him that you will move into the primary escapeway if the smoke becomes too heavy in the track.

When you have made your selection(s), do the next question.

Question F

You and your crew are now on the portal bus and have traveled outby 15 crosscuts. You noted the time when you started out. It was 10:35 P.M. It is now 10:40 P.M. Everyone is breathing with their SCSR. The smoke has become so thick that visibility is now about 100 ft. What should you do now? (Select as MANY as you think are correct.)

- 26. As you travel, count the number of crosscuts so you always know where the nearest mandoor is.
- 27. Stop the mantrip. Check the air in the primary escapeway (#3 entry) for smoke. If there is no smoke, you and your crew can walk out in fresh air.
- 28. Signal the operator to increase the speed of the portal bus so you can get out faster, before the smoke gets worse.
- 29. Signal the operator to reduce speed and proceed cautiously.
- 30. Talk to your crew to reassure them and explain what you are doing.
- 31. Take a deep breath on your SCSR, remove the mouthpiece and call the dispatcher on the haulage talkie to report your location, the smoke, that you are coming out slowly on the bus, and to ask for information about the fire.

When you have made your selection(s), do the next question.

Question G

You and your crew stay on the portal bus and continue on slowly for 12 more crosscuts. You check your watch and see it is almost 10:50 P.M. You passed the last mandoor 2 crosscuts back. The visibility has dropped to between 50 and 60 feet and it has begun to get difficult to see the stoppings in the crosscuts. The operator stops the bus, removes his mouthpiece and says, "I don't think I'll be able to see to go much further." What should you do now? (Select as MANY as you think are correct.)

- 32. Signal the operator to stop the bus. It is now time to start walking the track.
- 33. Signal the operator to continue, but go very slowly. You want to go as far as the next mandoor.
- 34. Signal the operator to put his mouthpiece back in and stop talking.
- 35. Signal the operator to tram the bus back to the last mandoor so that you and your crew can get into the primary escapeway in the #3 entry.

When you have made your selection(s), do the next question.

Question H

The visibility is continuing to get worse and you haven't heard from the dispatcher anymore. You travel 3 more crosscuts, look into the crosscut and barely see the mandoor. What should you do now? (Choose only ONE unless you are told to "Try again!")

- 36. Signal the operator to continue on slowly since you are waiting to hear from the dispatcher.
- 37. Signal the operator to stop the bus. Then, signal your crew to get off the bus and follow you through the mandoor.
- 38. Signal the operator to stop the bus. Get off the bus and tie one end of the 100 ft rope to yourself and the other end to a miner on the bus. While he remains on the bus holding the rope, take an extra SCSR with you and locate the mandoor. Open the door and check the #3 entry.
- 39. Signal the operator to stop the bus. Send a miner to locate the mandoor and then have the rest of the crew follow him while you call the dispatcher and tell him that you are going to move into the primary escapeway in the #3 entry.

Question I

You come back to the bus and motion for everyone to grab an extra SCSR. You then signal your crew to follow you and the rope into entry #3. The last miner brings the rope with him. Visibility in entry #3 is about 300 ft. What should you do now? (Select as MANY as you think are correct.)

- 40. Make a head count and check the time.
- 41. Select your most fit miner, give him an extra SCSR, and tell him to travel ahead and check out the escape route and mine conditions.
- 42. You, as a section foreman and former fireboss, have extensive knowledge of the mine. You place a miner who also knows the mine, the escape route, and escape procedures at the inby end of the rope while you take the lead at the head of the rope.
- 43. When you start to move the group out, set a fast but steady pace in order to minimize the time for your escape.
- 44. Signal each miner to grab the rope at equally spaced intervals.
- 45. When you start to move the group out, set a moderate and steady pace as you escape from the section.

When you have made your selection(s), do the next question.

Question J

After moving into the #3 entry, you and your crew travel about 1100 feet along the primary escapeway at which point you hit clear air. You know that you have reached the mains and that there is a mandoor nearby that leads to the track. You check the time and note that it is just after 11:00 P.M. What should you do now? (Choose only ONE unless you are told to "Try again!")

- 46. Take your SCSR off and tell the crew to do the same since many are having trouble breathing and the air is clear.
- 47. While your crew rests for a few minutes, send a miner who knows the escapeway to locate the mandoor that leads to the track.
- 48. Signal your crew to keep their SCSR mouthpieces in and to follow you as you lead them to the mandoor.
- 49. Tell the crew to rest while you go to call the dispatcher to see if he knows anything else about the fire.

You locate the mandoor leading to the track and feel it to see if it is warm. It feels cool to the touch. You open the door and find that the air is clear. You and your crew go through the door and come out into clear air in the track entry of the mains. Several mantrips are there waiting to take you and your crew out of the mine. Upon reaching safety, you learn that a belt mechanic's jeep is on fire in the first spur off 4 North track.

An investigation following the fire revealed that the mechanic parked the jeep in this spur while he was inspecting and lubricating the 4 North belt drive. Expecting to be at the belt drive only a few minutes, he did not knock the main power breaker. He accidentally left the controller in first point. As a result, the tram motor overheated and caused a fire.

END OF PROBLEM

Scoring your performance

1. Count the total number of responses you colored in that were marked "Correct". Write this number on the first line on the answer sheet.
2. Count the total number of incorrect responses you colored in. Subtract this number from 27. Write the difference in the second line on the answer sheet.
3. Add the numbers on lines one and two.
4. The best score is 49. The worst score is 0.

Appendix B: Answer Sheet Blanks

These are the answer sheet blanks. Copies of these blank answer sheets may be duplicated in the normal fashion. However, the answers that are found within the brackets must be printed on these blank answer sheets in invisible ink. These answers are found in Appendix C. If you have the capability to print invisible ink, make copies of the blank answer sheets. Make a master of the answers that appear in Appendix C. Then print the invisible ink on the blank answer sheets, being careful to make sure all pages print and that the appropriate answers line up with the appropriate blanks. The Master Answer Sheet shows all the answers in their proper places.

Most companies and trainers prefer to obtain copies of the preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

The exercise is designed to be used in small groups. You will need one answer sheet for each group of 3 to 5 persons in your class. The answer sheets are consumable. You will need a new set for each class.

A developing pen is also needed by each person who marks an answer sheet.

Answer Sheet for Travel Through Smoke

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need. The last part of the message may tell you what to do next.

Question A (Select as MANY as you think are correct.)

1. []
2. []
[]
[]
3. []
[]
4. []
[]

Question B (Select as MANY as you think are correct.)

5. []
6. []
[]
7. []
[]
8. []
[]
9. []
[]

Question C (Choose only ONE unless you are told to "Try again!")

10. []
11. []
[]
12. []
13. []
[]
[]
[]
14. []
[]

Question D (Select as MANY as you think are correct.)

15. []
16. []
17. []
[]
18. []
[]
[]
19. []
[]
20. []

Question E (Select as MANY as you think are correct.)

21. []
[]
[]
[]
22. []
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[]
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23. []
[]
[]
[]
24. []
[]
25. []
[]
[]

Question F (Select as MANY as you think are correct.)

26. []
27. []
[]
28. []
29. []
[]
30. []
[]
[]
31. []
[]

Question G (Select as MANY as you think are correct.)

32. []
[]
[]

33. []

34. []
[]

35. []

Question H (Choose only ONE unless you are told to "Try again!")

36. []
[]

37. []

38. []
[]
[]
[]

39. []
[]
[]

Question I (Select as MANY as you think are correct.)

40. []

41. []

42. []
[]

43. []

44. []

45. []
[]
[]
[]

Question J (Choose only ONE unless you are told to "Try again!")

46. []
[]
47. []
[]
[]
48. []
[]
49. []
[]
[]

End Of Problem

Finding your score

Number of "Correct" answers you colored in = (1) _____

27 minus number of incorrect answers you colored in = (2) _____

Add lines one and two to get your total score = (3) _____

Highest possible score = 49

Lowest possible score = 0

Appendix C: Invisible ink Answers

These pages contain the answers that must be printed in the blanks of the answer sheet in Appendix B. These answers are spaced and sequenced correctly so that they exactly match up with the appropriate blanks on the answer sheet blank.

Once the answers have been printed in the answer sheet blanks, the developing pen reveals the formerly invisible printed message.

You may obtain preprinted answer sheets or you may prepare your own copies. To learn more about these options, and to determine how many answer sheets and developing pens you will need, see the introductory section of the Instructor's Copy.

Correct. This alerts the others and provides you with more information.

Finding the source of the smoke is important, but the safety of your crew is the number one priority. If the crew smells smoke and finds you and the bus gone, they may be alarmed.

Correct. You should make a quick inspection to confirm that the source of the smoke is not on your section.

As foreman, you should not depend on second hand information. You should talk to the dispatcher yourself.

Pulling equipment from the face wastes time.

This action splits up your crew and restricts your options. You may need the portal bus to escape.

Correct. He tells you that there are no other vehicles on your section at this time.

You have a problem now. Time may be precious and your escape may be compromised if you fail to act promptly.

Correct. The dispatcher says he'll do that right away and get back to you as soon as possible.

Correct. Everyone is present. Do the next question.

This wastes time. A fire could cut communications and/or block your escape while you wait by the phone. Try again!

Unnecessary and this wastes time. Try again!

You should not leave the phone. It is probably a good idea to pressurize that entry to help reduce the amount of smoke in that entry. But you haven't already planned for this and it would take too much time to do it now. Try again!

The FSR should be used only to get to the SCSRs, or only as a last resort when the SCSRs have been exhausted. Try again!

Correct. You may need these later.

You don't need this and it will slow you down.

You need to get the SCSRs on the crew now. At this time you and they could be breathing potentially fatal air.

Correct. Two miners didn't have their nose clips on and three others had poor strap adjustment. These problems need to be corrected before the crew begins to move out.

Correct. He needs this information, even if he doesn't have any information for you.

Correct. You may need this information later. It is 10:35 P.M.

You have a long distance to travel on foot, you don't know where the fire is, and although there is some smoke, it could get worse later. You should ride as far as you can on the portal bus because it is quicker and will take less energy for you and your crew.

Correct. You will be wearing an SCSR and won't be able to communicate well. Since you will be in smoke either way you go, it is probably better to ride. He says there is still no information about a fire but he will keep you posted. He suggests that you can answer his questions about your progress by clicking your haulage talkie mike twice for yes and once for no.

Correct. The choice is whether to walk in the intake smoke or ride out the smoky secondary. You will therefore probably be traveling the track entry and the smoke may get heavier. To ensure the safety of your crew there should be no vehicles on the track.

He should be communicating with you as you ride out on the portal bus. Besides, you may be in heavy smoke at the mouth of the section.

Correct. Visibility will be reduced as the smoke becomes thicker. If it becomes too thick, it may become impossible to find a mandoor that leads to the primary escapeway.

Correct. Any stops of the portal bus should be at mandoors.

This wastes time. You need to go as far as possible with the least effort. Riding the portal bus is the best way to do this.

If you go faster you could wreck.

Correct. Riding the bus is still the quickest means of escape and traveling slow will help prevent possible problems.

Don't remove your SCSR mouthpiece and nose clip. This encourages your crew to do the same and people may die. Communication should be by hand, lamp signal, or written note.

Never remove the SCSR mouthpiece or nose clips until you are outside, in known fresh air, unless you need to don a new unit!

Visibility is poor whether you are riding or walking and will likely get worse with time. Besides, there may be tripping and stumbling hazards in the smoke. You have better options.

Correct. The portal bus is still the best way to travel provided you go slowly.

Correct. You and the crew should not be taking the SCSR mouthpieces out to talk. This is very dangerous.

This delays your escape by going inby rather than outby.

The dispatcher may not have any more information to give you. Also, the talkie communications could be lost due to the fire. Try again!

This may separate the crew or disorient them. Try again!

Correct. Since the visibility is getting worse in the alternate escapeway, you need to check the primary escapeway to see if the visibility is better. You find that there is light hazy smoke in #3. The lifeline keeps you in contact with your crew. Do the next question.

You and your crew may become separated. You also told the dispatcher earlier that you might move into the primary escapeway if the smoke became too heavy. Try again!

Correct. Everyone is present. It is now 10:55 P.M.

You should keep the group together.

Correct. This way you will have someone to help at both ends of the line.

This may create problems. Move at a deliberate pace.

Correct. This can help keep the group together.

Correct. This will help the miners adjust to breathing with their SCSRs while they are walking, help them to avoid hyperventilating, and help prevent "cheating" by taking extra breaths of the mine air around the SCSR mouthpiece.

Although you are in clear air, CO may be present. Also, smoke can come in at any time. You and your crew need to keep your SCSRs on. Try again!

Even though you are in clear air, smoke can come in at any time. Your crew needs to stay together as a group so that no one becomes separated.
Try again!

Correct. You and your crew need to keep your SCSRs on since CO might be present. You and your crew also need to stay together.

You need to stay with your crew so that you don't become separated.
Besides, there may not be a mine phone close that can be safely reached.
Try again!